State of CERES

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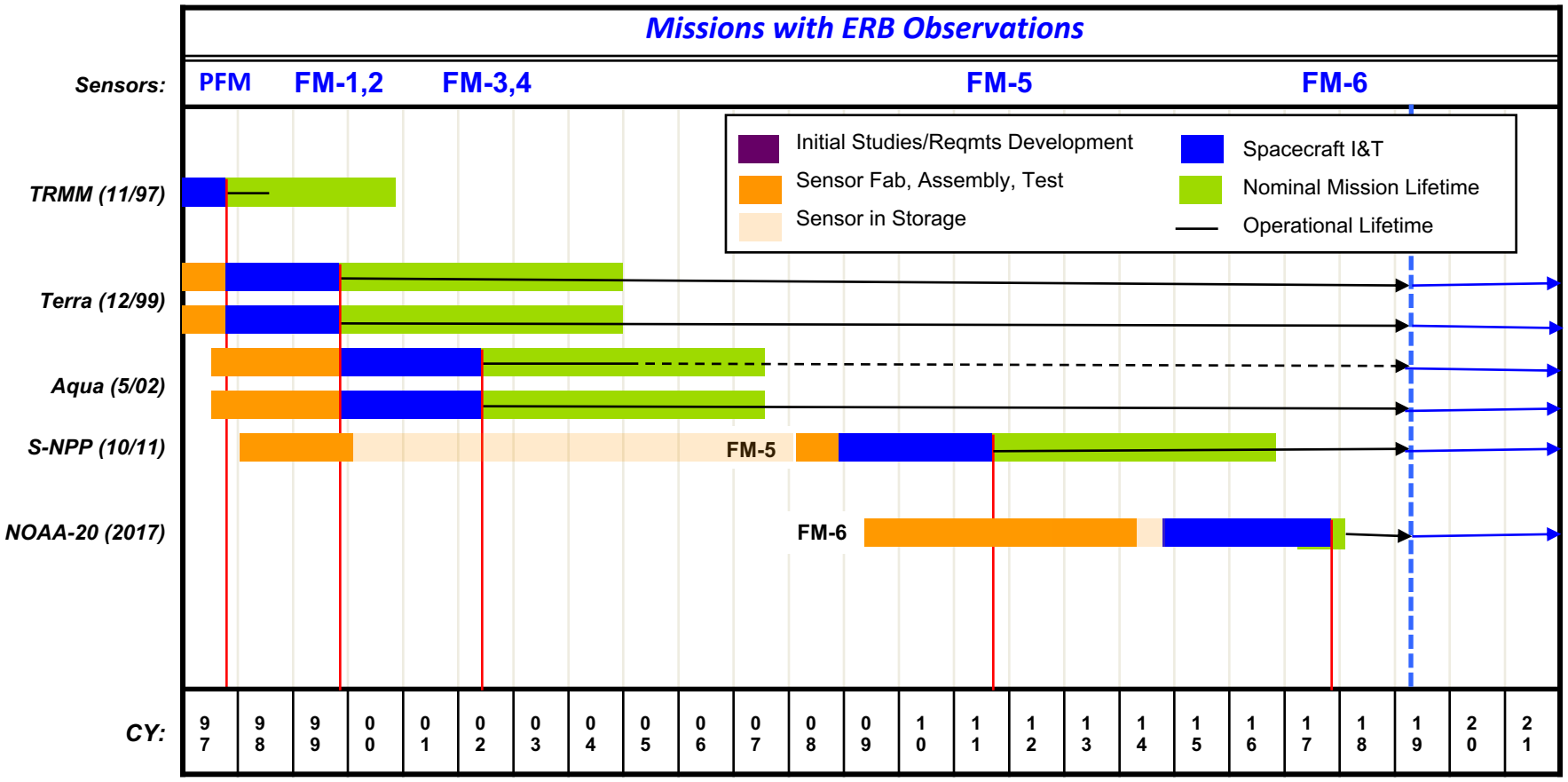
CERES Science Team Meeting, May 7-9, 2019
NASA LaRC

CERES Meeting

Review Status of CERES Instruments and Data Products:

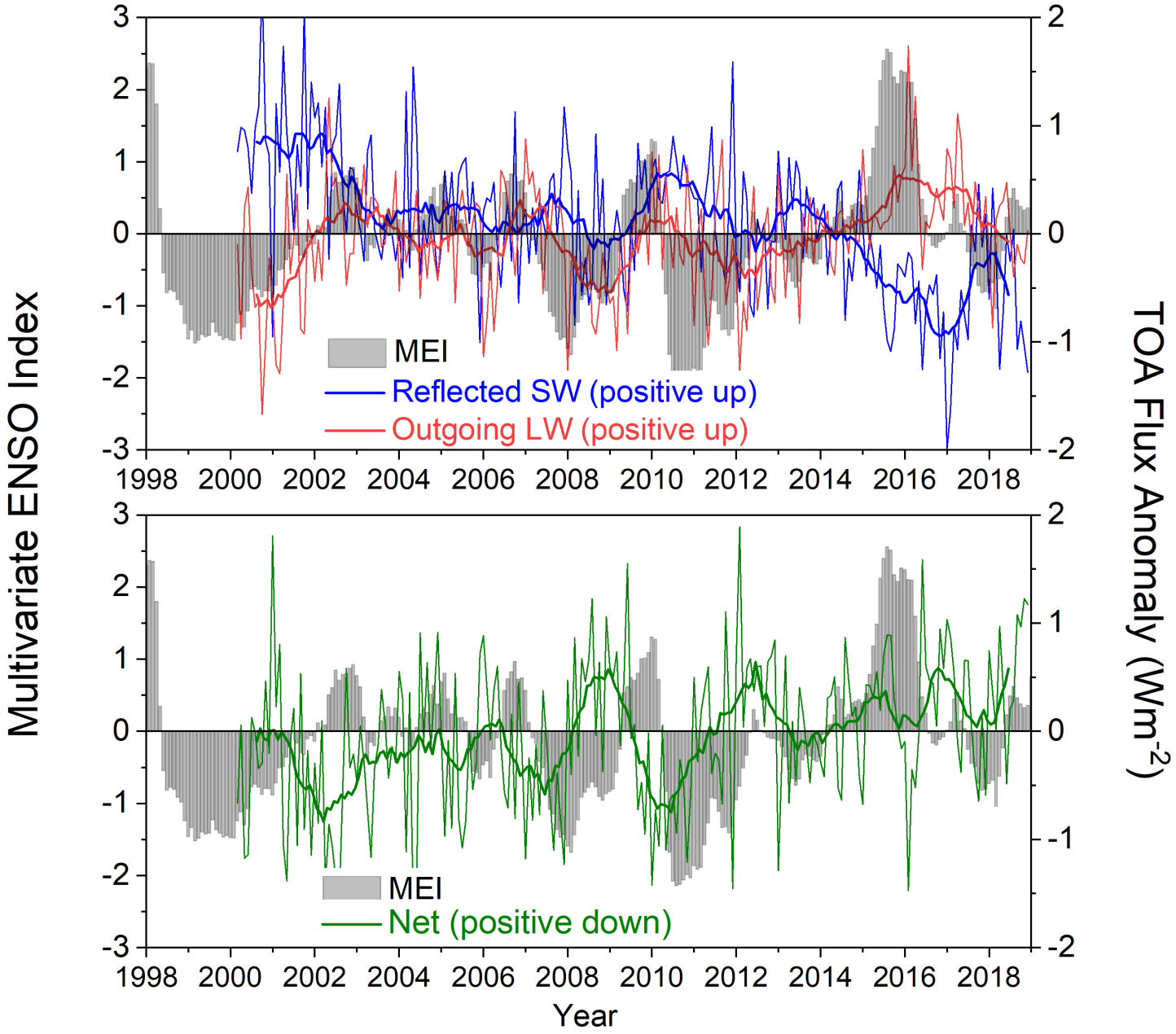
- Terra & Aqua Edition 4.1 release (SSF1deg, SYN1deg, EBAF)
- SNPP Ed2 Plans
- CERES Terra, Aqua, S-NPP, NOAA-20 SW/LW/TOTAL Channel Calibration Update
- MODIS & VIIRS Cloud Algorithm & Validation Status
- ADM, SOFA, SARB and TISA Working Group Reports
- FLASHFLUX Update
- Data Management Team Update
- ASDC Update

CERES Flight Schedules



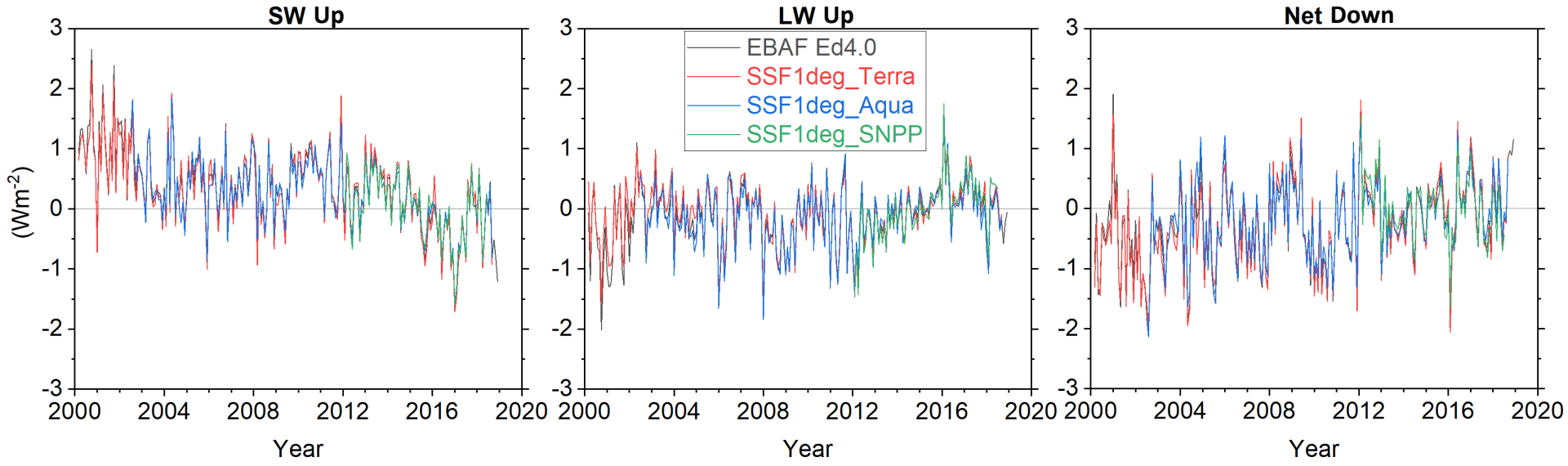
- Currently, 6 CERES instruments fly on 4 satellites: Terra (L1999), Aqua (L2002), SNPP(L2011), NOAA-20 (L2017)

Global Mean All-Sky TOA Flux Anomalies & Multivariate ENSO Index (CERES EBAF Ed4.0; 03/2000 – 12/2018)



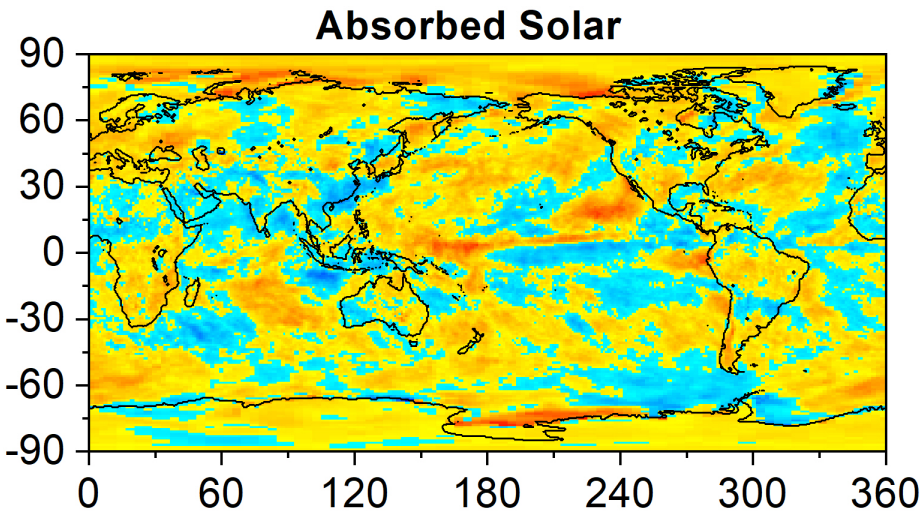
Global Mean TOA Flux Anomalies

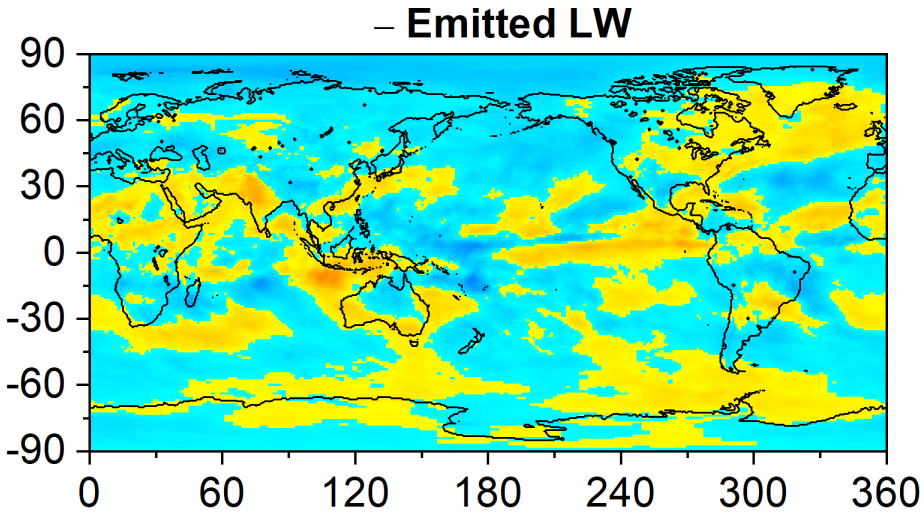
(Relative to Climatology for 02/2012-07/2018)

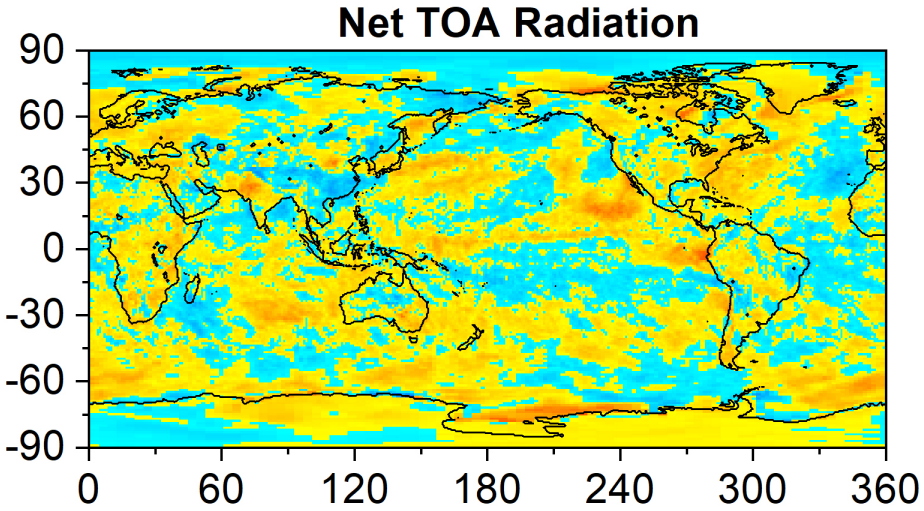


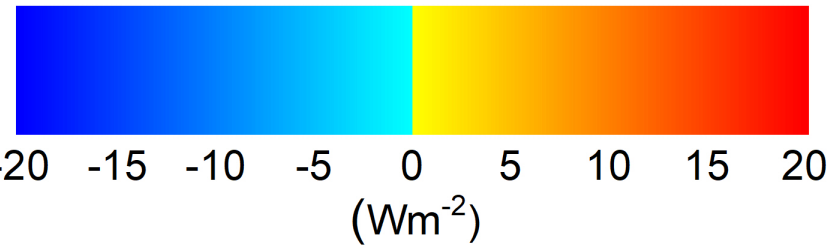
- RMS differences between Terra, Aqua and SNPP monthly anomalies for common period are: < 0.2 Wm^{-2} for SW and LW, and < 0.25 Wm^{-2} for net TOA flux.

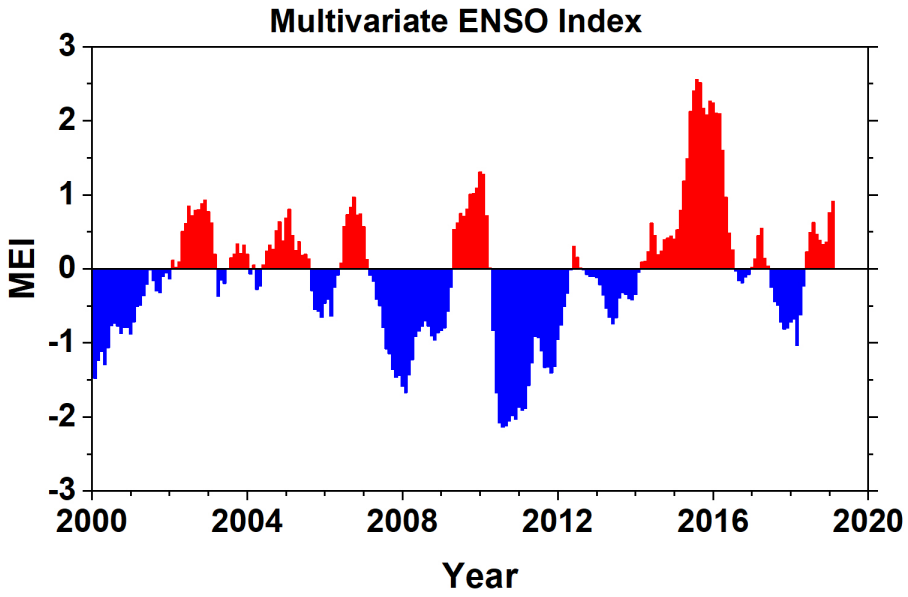
TOA Radiation Changes (03/2000 – 12/2018)



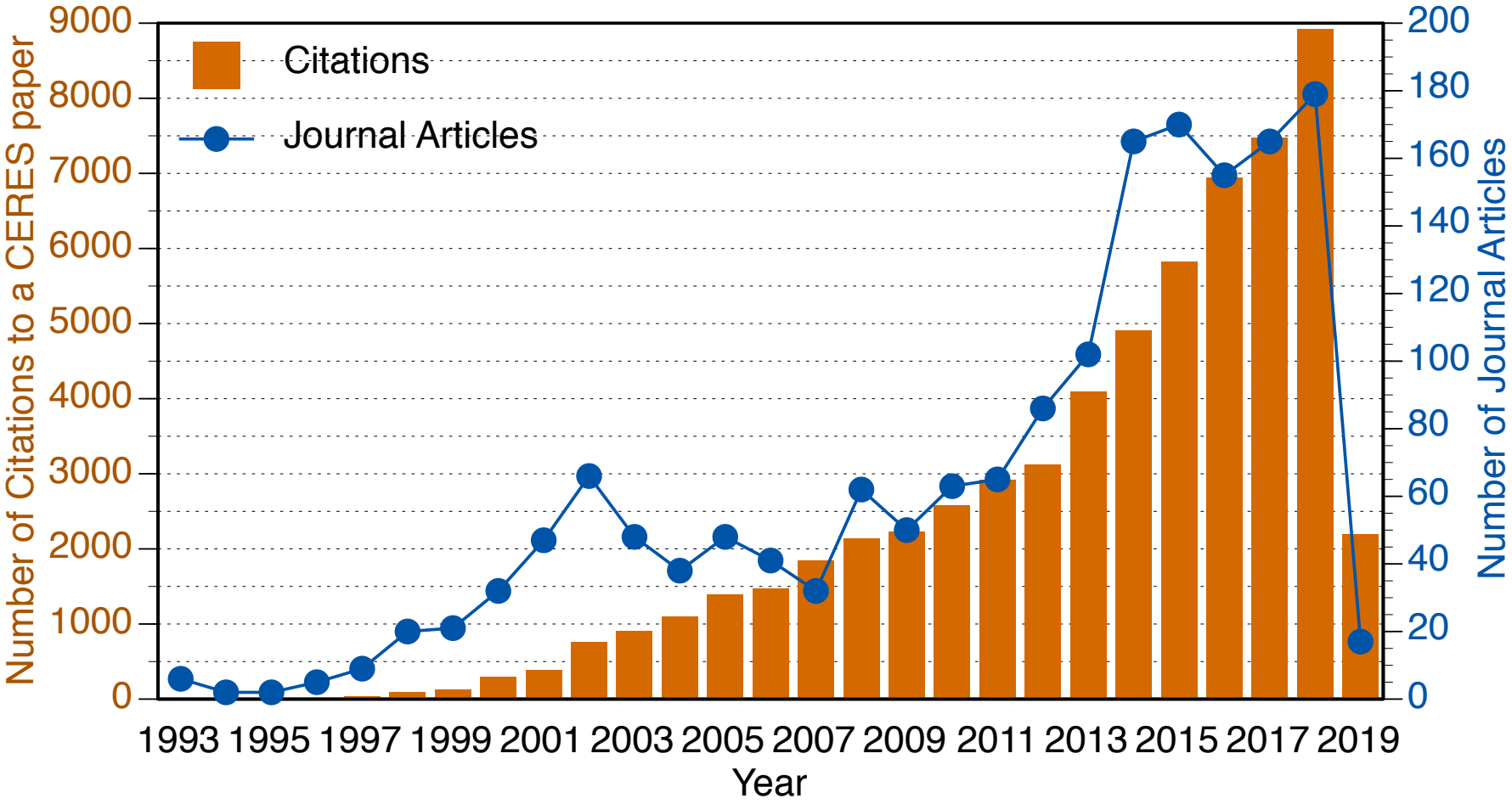








CERES Journal Publications and Citation Counts
(For Papers Between 1993-2019; Updated April 30, 2019)



- Total number of peer-reviewed journal articles: 1,696
- Total number of citations to CERES papers: 61,826

(Compiled by Anne Wilber & Dave Kratz)

Number of Unique Users by CERES Data Product
(through April 30, 2019)

Level	Product	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1b	BDS	11	9	14	19	14	11	13	14	10	4
2	SSF	84	77	138	223	247	253	278	327	235	97
	FLASH_SSF	25	8	15	23	30	61	41	68	101	29
	C3M	31	32	33	37	28	55	54	49	49	13
	ES8	22	20	18	31	16	21	15	15	10	2
	SSF-MISR	9	4	2	5	4	2	1	3	1	1
3 & 3b	EBAF-TOA	72	160	346	484	579	580	540	646	668	249
	EBAF-Surface			147	289	375	424	464	510	484	221
	SYN1deg	70	139	188	331	375	431	483	607	639	319
	SSF1deg	77	126	107	157	166	160	194	190	159	88
	CldTypHist	17	12	37	57	41	40	47	86	87	26
	ES4	59	36	11	27	19	13	12	17	17	7
	ES9	21	12	5	13	9	5	5	8	6	2
	FLASH_TISA	17	18	20	17	15	15	36	52	65	16

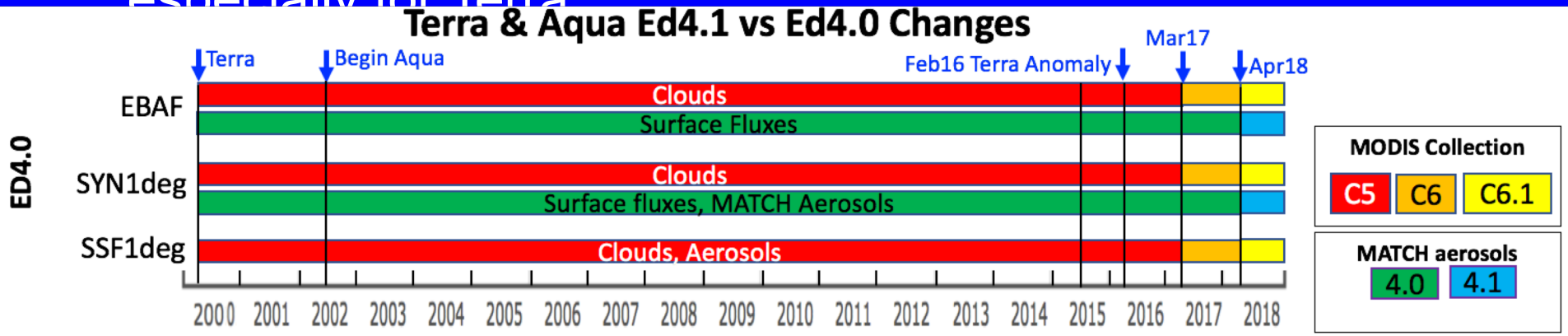
- **67,410 unique Applied Science users ordered CERES data products via the POWER Web Portal**

CERES Terra and Aqua Data Product Availability

Data Product	Level	Ed4.0
BDS	1	12/2018
SSF	2	12/2018
SSF1deg	3	11/2018
SYN1deg	3	10/2018
CldTypHist	3	01/2018
EBAF-TOA	3b	12/2018
EBAF-SFC	3b	03/2018

Terra & Aqua Edition 4.0

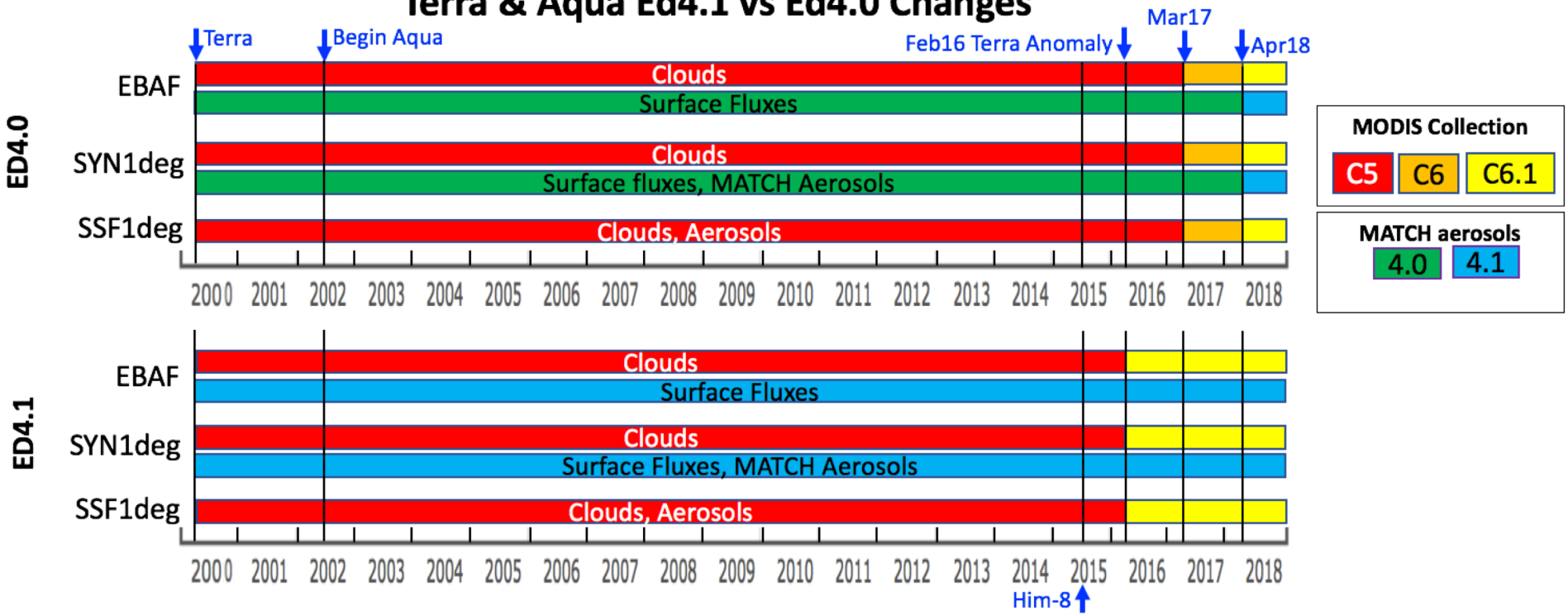
- The CERES Terra & Aqua Edition 4.0 processing uses MODIS radiances and aerosols as key inputs.
- CERES Edition 4.0 started with MODIS Collection 5. However, C5 processing at GSFC was terminated at data date February 2017 and superseded with MODIS Collection 6.
- MODIS C6 has been superseded with MODIS Collection 6.1.
- MODIS Collection 6.1 is a major calibration upgrade for select Terra (6.72 and 8.6 μm) and Aqua (visible) channels.
  - Significantly improves the quality of the MODIS cloud mask, especially for Terra



Terra & Aqua Edition 4.1

- CERES Team has reprocessed Level 2 SSF and all downstream Level 3 products with MODIS C6.1 starting in March 2016, when the MODIS Terra water vapor channel showed a large spurious loss of sensitivity.
- In addition, CERES SYN1deg and EBAF SFC fluxes were reprocessed for the entire CERES record because of a large discontinuity in aerosol optical depths between MODIS C5 and C6.1. AODs are assimilated in MATCH and used to compute surface fluxes.
- EBAF all-sky TOA fluxes remain unchanged between Ed4.0 and Ed4.1.
- Introducing new clear-sky fluxes in EBAF Ed4.1. Definition is more in line with that used in climate models.
- CERES data for 03/2000-02/2016 will not be reprocessed until Ed 5.

Terra & Aqua Ed4.1 vs Ed4.0 Changes



Parameter	ED4.0	ED4.1
MODIS-collection	Terra-MODIS 6.7, 8.6 µm striping, March 2016 to March 2018	MODIS C6.1 resolved the Terra-MODIS 6.7, 8.6 µm striping
MATCH-Edition	Large discontinuity between MODIS C5 & C6.1 AOD inputs	Uses MODIS C6.1 AODs as input for entire CERES record
MODIS Clouds	Impacted Terra cloud properties	Terra cloud properties corrected beginning in Feb 2016
GEO Clouds	Him-8, GOES-16,17, Met-8,11 cloud codes with bugs	Consistent cloud code using MATCH Ed4.1, begin July 2015
Surface fluxes	The clear-sky SW down surface flux was impacted by MODIS C5 & C6.1 AOD discontinuity	SYN surface fluxes, computed using consistent GEO cloud code with MATCH Ed4.1 and tuned fluxes to correct GEO TOA flux

Planning for Terra & Aqua Edition 5

Main Considerations:

1) GMAO improvements to their atmospheric reanalysis system.

   - CERES and GMAO hold WebEx meetings every 3 weeks to gauge progress and provide ongoing validation results for the latest GEOS FP or FPIT version.

2) MODIS Collection 7 schedule.

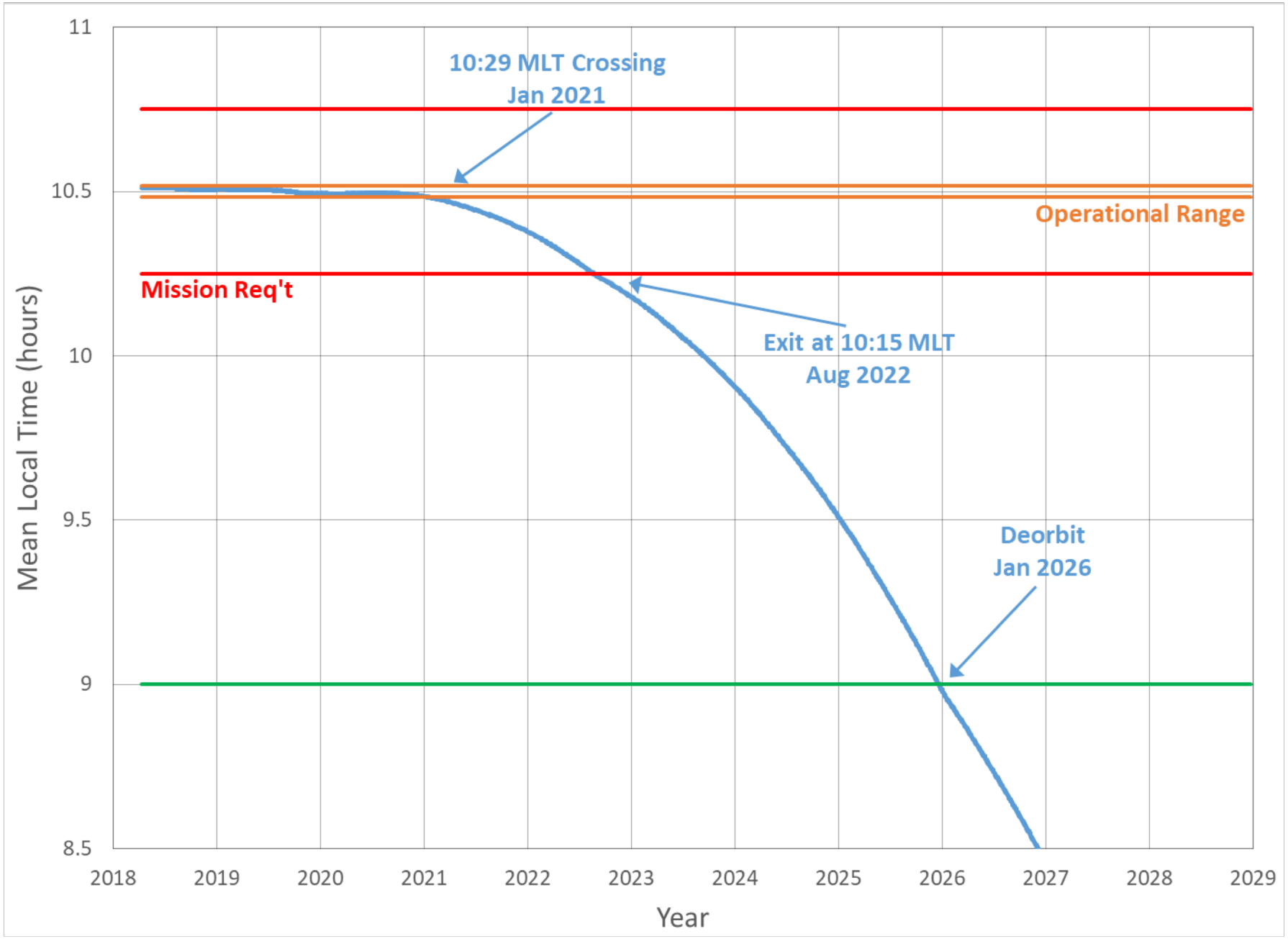
3) Changes to Terra and Aqua MLT.

   - MLT starts to drift in 2021 (Terra) and 2022 (Aqua)
   - Ideally, this would be a good time to transition CDR from Aqua to NOAA-20 or S-NPP.

4) CERES production code improvements.

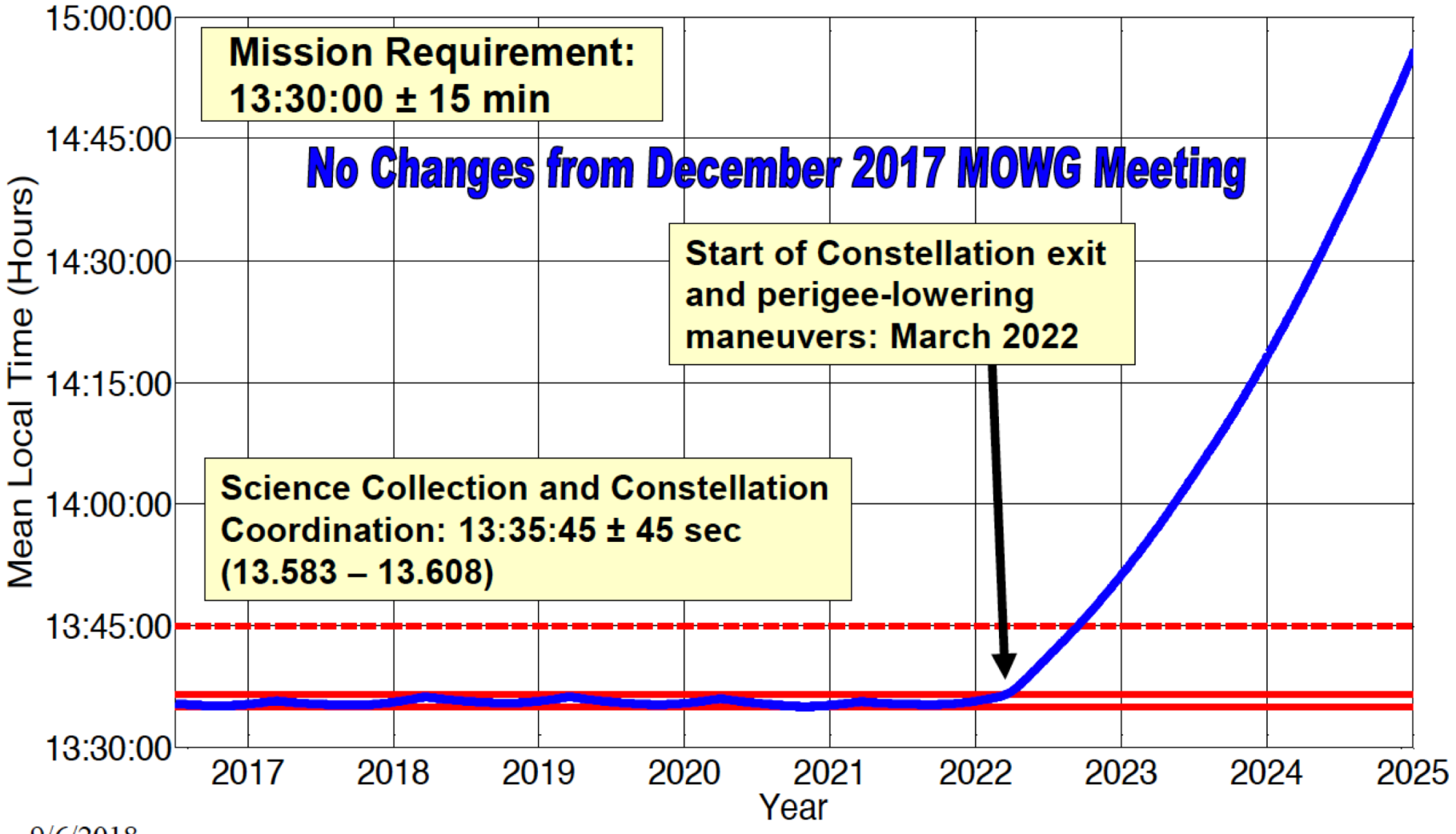
5) CERES algorithm improvements (particularly those enabling a seamless transition across satellite platforms).

Terra Predicted Mean Local Time



Presented at ESC/A-Train MOWG Meeting on 12/6/2017

Aqua Predicted MLT with A-Train exit in March 2022



Terra and Aqua Mission Budgets

- The in-guide budgets for Terra, Aqua and Aura provided by NASA HQ this year are significantly lower in FY23 and beyond compared to last year's in-guide budget.
- The new in-guide budget ends data collection on Terra and Aqua 3-3.5 years sooner than what is achievable based upon available fuel and orbit drift considerations.

  ⇒ Significantly increases risk of a data gap in ERB record.
- All three missions submitted over-guide requests at this year's annual budget review (PPBE) to restore the funding levels in last year's in-guide budget.
- Terra and Aqua will also make the case to restore the funding during the upcoming Senior Review in spring 2020.
- The in-guide budget for the Radiation Budget Science Project has not changed since last year.

S-NPP Edition1 Product Availability

Product	Platform	Processed through	Current	Publically Available
BDS	S-NPP	03/2019	Yes	Yes
SSF	S-NPP	01/2019	Yes	Yes
SSF1deg-Hour	S-NPP	12/2018	Yes	Yes
SSF1deg-Day/Month	S-NPP	12/2018	Yes	Yes
SYN1deg	Terra+S-NPP	11/2017	Yes	Yes

S-NPP Plans

Edition 1:

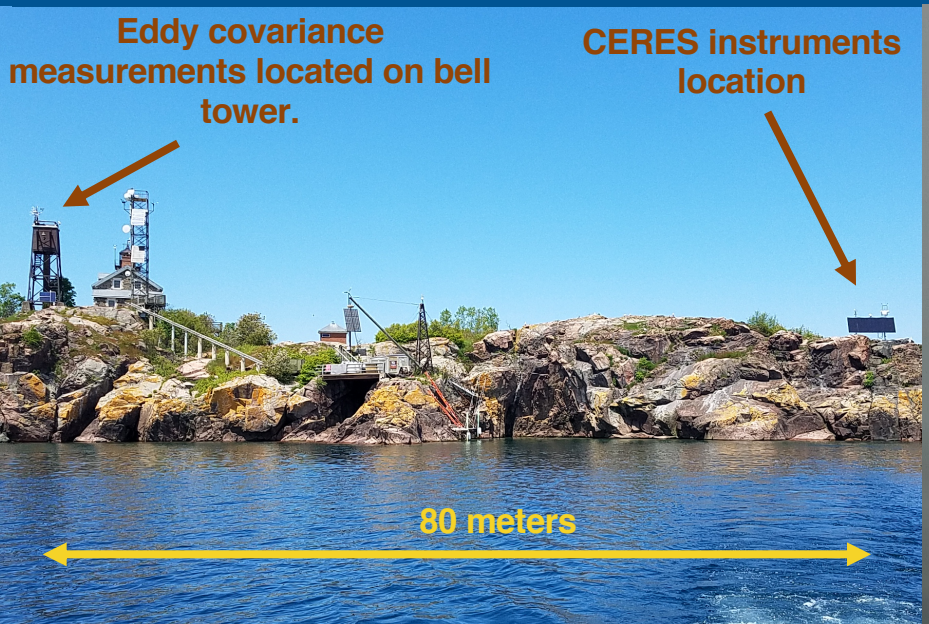
- Instrument gains (from onboard calibration) were taken into account. No attempt was made to place FM5 on same radiometric scale as FM3 or correct for spectral response function changes with time.
- ED1 cloud retrieval, ADMs, TISA & SARB algorithms were based upon those from Aqua.
  - Some changes to VIIRS cloud mask since water vapor and CO_2 bands are unavailable.
  - Cloud retrieval look-up tables were recomputed for VIIRS bands.

Edition 2:

- Will place FM5 on same radiometric scale as FM3.
- Will correct for FM5 spectral response function changes with time (LW daytime only).
- Will place VIIRS on same radiometric scale as MODIS Aqua, use the latest version of VIIRS level 1b, tune VIIRS cloud mask to be consistent with MODIS-Aqua.
- Will not ingest CrIS WV & CO_2 radiances to supplement VIIRS.
- Considering placing SNPP in a restricted RAP mode to enable ADMs to be constructed.

Granite Island

- New location surface validation site.
- 2.5 acre island located about 5 miles offshore in Lake Superior.
- The island already hosts eddy covariance measurements for the Great Lakes Evaporation Network (GLEN).
- Shortwave, longwave, and AERONET instruments installed on the island in June 2018.
- Site accepted by BSRN in July, 2018.
- Actively working a seagull problem.
- **Site was inspected and "Winterized" last Fall.**
- **Added stiff wire to tracker to discourage birds.**
- **Tracker malfunctioned November 4; were unable to get a crew to inspect the problem because of bad weather and ice.**
- **No data except global shortwave since November 4.**
- **Spring trip is planned sometime during last two weeks of May.**



Upcoming Conferences & Meetings of Interest

IUGG General Assembly
- July 8-18, 2019, Montreal, Quebec, Canada.

Gordon Research Conference: Radiation & Climate
- July 21-26, 2019, Bates College, Lewiston, ME, US.

CFMIP Meeting on Clouds, Precipitation, Circulation, and Climate Sensitivity
- Sep 30-Oct 4, 2019, Mykonos, Greece.

Fall 2019 CERES Science Team Meeting
- October 29-31, 2019, Lawrence Berkeley National Laboratory, Berkeley, CA.

Fall AGU
- December 9-13, 2019, San Francisco, CA.

End